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Attorney Docket No. LD 11411
GEC 2 0489

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of:

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For: **IR-COATED HALOGEN LAMP USING REFLECTIVE END COATS**

1. **Type of Application**

This new application is **not** a provisional application.

2. **Papers Enclosed Which Are Required For Filing Date under 37 CFR 1.53(b) (Regular) or 37 CFR 1.153 (Design) Application**

_7_ Pages of specification

_3_ Pages of claims

_1_ Page of Abstract

_3_ Sheets of Drawings - FIGURES 1-5 (informal)

_X_ A partially executed Declaration for Patent Application

3. **Language**

xxx English

4. **Assignment**

____ An assignment of the invention to **GENERAL ELECTRIC COMPANY** is enclosed, with a separate transmittal letter and fee.

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this New Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on **June 26, 2000** in an envelope as "Express Mail Post Office to addressee," **Mailing Label Number EL53041198975US**, addressed to the Commissioner of Patents and Trademarks, **Box Patent Application**, Washington, D.C. 20231

By: Chuck Dunbar

5. **Fee Calculation (37 CFR 1.16)**

xxx Regular application

Basic Fee		$ 690.00	$ 690.00
Total claims	20 - 20 =0	x $ 18.00	
Independent claims	2 - 3 = 0	x $ 78.00	
	Total fee		**$ 690.00**

6. **Fee Payment Being Made at This Time -Method of Payment of Fees**

xxx Check in the amount of **$ 690.00** is enclosed.

7. **Authorization to Charge Additional Fees**

The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Deposit Account No. **06-0308**:

37 CFR 1.16(a), (f) or (g) (filing fees),
37 CFR 1.16(b),(c), and (d) (presentation of extra claims); and
37 CFR 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application).

8. **Instructions as to Overpayment**

xxx Credit Account No. 06-0308

Respectfully submitted,

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IR-COATED HALOGEN LAMP USING REFLECTIVE END COATS

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates generally to halogen infrared lamps with reflective coatings on the lamp envelope. More particularly, this invention relates to halogen infrared lamps coated with an infrared reflective coating substantially surrounding the entire envelope along with a totally reflecting coating disposed on ends of an ellipsoidal portion of the envelope.

Discussion of the Art

Improving the efficiency of lamps is increasingly important due to the rising cost of energy. Infrared reflective filters, a form of interference filters, have been used to improve the energy efficiency of lamps by reflecting infrared radiation towards the filament to heat the filament and thus increase the efficacy of the lamp. Interference filters have also been used to selectively reflect or transmit light radiation from certain portions of the electromagnetic radiation spectrum such as ultraviolet, visible, and infrared radiation. Interference filters have been used to allow a portion of the visible radiation to transmit through the envelope and reflecting the unwanted visible radiation to produce colored light.

A halogen infrared (HIR) lamp uses an infrared (IR) reflective coating on an elliptical surface of a double ended quartz halogen lamp to preferentially reflect IR radiation to a filament. This coating, however, allows some IR radiation to pass since the reflectivity in the IR region is not one hundred percent. Metal halide discharge lamps have used reflective end-coats to improve the efficacy of lamps by heating up the ends where a metal halide pool forms, thereby increasing the vapor pressure of the pool and therefore the efficacy. Moreover, computer modeling has uncovered that in HIR lamps, IR radiation is preferentially lost at particular angles as measured from the radial axis formed along the filament. If an HIR lamp recaptures

the IR radiation lost at these particular angles by using an additional reflective end-coating, similar to metal halide discharge lamps, it is believed that the efficacy of the lamp can be improved.

BRIEF SUMMARY OF THE INVENTION

The present invention is directed to a totally reflecting coating placed near the ends of a HIR lamp to reflect visible and IR radiation at low acute angles and large obtuse angles as measured from an axis defined along the filament. The totally reflecting coating reflects visible and IR radiation towards the filament to heat the filament. Due to the fact that more IR radiation is lost at these angles compared to visible light, the net effect is to return more IR radiation to the coil, thereby heating the coil and increasing the efficacy of the lamp.

The light source is comprised of a light transmissive lamp envelope having a filament centrally disposed within the envelope. The envelope described above has an ellipsoidal portion located centrally between two tubular portions disposed on opposite ends of the ellipsoidal portion. An IR reflective coating substantially surrounds the entire ellipsoidal portion of the envelope and a totally reflecting coating is located on ends of the envelope.

A pair of lead wires are connected to opposite ends of the filament. In another embodiment, the light source may have lead wires extending from only one end of the lamp.

One exemplary embodiment of the lamp has an IR reflective filter coating containing alternate layers of materials with different refractive indices. These different refractive indices allow desired radiation through while reflecting the unwanted radiation. The present invention advantageously provides a totally reflecting coating near the ends of the HIR lamp to preferentially reflect the IR radiation that usually would escape and direct it towards the filament.

The totally reflecting coating on both ends of the envelope preferably subtends an angle from approximately 22° to approximately 45° from the filament axis and surrounding the entire envelope.

A primary benefit of the invention resides in the increased efficacy associated with the subject lamp.

Another benefit of the invention relates to the simple manner in which efficacy of the lamp can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 illustrates an HIR lamp in accordance with one embodiment of the present invention.

FIGURE 2 illustrates an HIR lamp in accordance with a second exemplary embodiment of the present invention.

FIGURES 3 and 4 are a graphical representation of the radiation emitted from the lamp in the visible and IR regions, respectively, relative to the angle from the lamp axis.

FIGURE 5 is an elevational view partially in cross-section of a directional lighting system (PAR 38 reflector) employing features of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Exemplary embodiments of the invention are shown in FIGURES 1 and 2 and illustrate a light source or lamp **100** comprising a double-ended envelope **102** having a central ellipsoidal portion and tubular portions extending from each end thereof and housing a filament **104**. The filament **104** is electrically and mechanically

connected at first ends by first and second lead wires **110, 112**, respectively. The envelope **102** contains a halogen gas and a fill-gas. The halogen gas in the present invention is a halogen mixed with methyl bromide; however, other gas mixtures are encompassed by the scope of the present invention. The fill gas is preferably selected from the group consisting of xenon, krypton, argon and mixtures of these gases with nitrogen.

The filament **104** extends longitudinally along a major axis of the ellipsoidal portion of the envelope **102**. In the preferred embodiment, the filament **104** is a tungsten material and is a coiled-coil type filament, although other filament material and configurations are not outside the scope of the present invention. First and second seals **114, 116** are provided at opposite ends of the envelope **102** in a manner that is well known in the art.

An IR reflective film **118** is provided on the outer surface of the envelope **102**. In the preferred embodiment, the IR reflective film **118** is deposited on the envelope **102** by vapor deposition or sputtering; however, the IR film **118** may be deposited on the envelope **102** by other methods. The IR reflective film **118** acts in concert with the ellipsoidal shape of the envelope **102** and the placement of the filament **104** along the major axis **A** of the ellipsoidal portion of the envelope **102** to perform multiple functions. First, the IR film **118** reflects IR radiation emitted by the lamp towards the filament **104** in order to increase the efficacy of the light source **100.** Second, the IR film **118** allows other portions of the radiated spectrum, including visible radiation emitted by the filament **104,** to pass through the envelope **102**

It is desired, though not necessary, that the IR film **118** have the optical and temperature properties similar to the filter disclosed in U.S. Patent No. 4,229,006 The IR film **118** of the exemplary embodiment is a composite or a plurality of stacked layers comprised of alternating high refractive materials and low refractive materials The IR film has transmittance and reflectance characteristics capable of withstanding and operating effectively at an elevated temperature of, for example 600° Celsius, for a prolonged period of time. The IR film **118** advantageously allows visible radiation to pass through the envelope **102** while reflecting IR radiation towards the filament **104**.

In the first embodiment, as shown in FIGURE 1, the totally reflecting coating **120** is disposed on both ends of the envelope **102** subtending an angle from approximately twenty two degrees (22°) to approximately forty five degrees (45°) from the major axis **A** of the ellipsoidal portion of the envelope at each end (i.e., also extending from one hundred thirty five degrees (135°) to approximately one hundred fifty eight degrees (158°) from the major axis). In the second embodiment, illustrated in FIGURE 2, the totally reflecting coating **120** is disposed on both ends of the ellipsoidal portion of the envelope **102** subtending an angle from approximately twenty two degrees (22°) to approximately forty five degrees (45°) from the major axis **A** of the envelope, as well as covering at least a portion of the tubular portions of the envelope. Preferably the portion of each tubular portion surrounding the seal region is not coated. The totally reflecting coating **120** can be made from silver, aluminum or any other desired reflective material exhibiting similar properties.

In developing the invention, it was determined that IR radiation escapes the envelope **102** even when it is covered by the IR reflective coating **118.** In particular, the coating is less effective at acute angles measuring less than approximately thirty degrees (30°) from the major axis **A** of the ellipsoidal portion of the envelope **102** and at obtuse angles measuring approximately one hundred fifty (150°) from the major axis. The totally reflecting coating reflects the IR radiation (as well as the visible radiation) that is escaping at these angles towards the filament. By preferentially reflecting this IR radiation (and also the visible radiation) towards the filament **102** that would otherwise pass through a lamp envelope having only an IR film, the efficacy of the light source **100** is improved. In the first embodiment as shown in FIGURE 1 the totally reflecting coating is disposed on both ends of the envelope subtending an angle from approximately twenty two (22°) to approximately forty five degrees (45°) from the major axis (or as measured to the opposite end as an obtuse angle from approximately one hundred thirty five degrees (135°) to one hundred fifty eight degrees (158°)) of the ellipsoidal portion of the envelope **102**. In the second embodiment of FIGURE 2, the totally reflecting coating **120** is disposed on both ends of the ellipsoidal portion of the envelope (from approximately twenty two degrees (22°) to forty five (45°)), as well as the tubular portions of the envelope . By

preferentially reflecting this IR radiation towards the filament **102**, the efficacy of the light source **100** is improved.

FIGURES 3 and 4 are graphical representations of a modeled angular distribution of output radiation in the visible and IR regions, respectively. As is evident, there are peaks at approximately thirty degrees (30°) and one hundred fifty degrees (150°) for the IR radiation. Thus, by recapturing the IR radiation at the low angles, i.e., zero to thirty degrees (0°-30°) and one hundred fifty to one hundred eighty degrees (150°-180°), through use of the additional reflective end coat, the efficacy is improved. Since it is believed that the IR reflection is based on the angle of incidence, the empirical model was validated qualitatively by subsequent measurement. The visible region, as represented in FIGURE 3, starts to reflect at the extreme angles, thus resulting in the graphical representation of FIGURE 3.

It is estimated that lamp efficacy may be improved on the order of approximately four percent (4%) by using the totally reflective end coatings on the ends of the envelope. The end coats are relatively inexpensive to add since they involve only a single layer and the technology of coating silver, aluminum, or a similarly functional reflector material is well known.

Although there is consideration that heating of the tubes in the embodiment of FIGURE 2 where the reflective coating extends to the tubular portions, and may effect the pinch seal on the molybdenum foil, the benefits offered by improved efficacy will dictate the optimization and the exact placement or extent of the coating.

It will also be appreciated that when the filament tube is used in a directional lighting system, the system can be optimized by matching the reflective end coat region with the desired reflecting areas of the reflector. Thus, as illustrated in FIGURE 5, the useful emitting angles of the filament tubes are alpha (α) and gamma (γ), so that total reflective layers made of aluminum, nichrome, or other material which ensures specular reflection enhances the efficacy of the overall system.

The invention has been described with reference to the preferred embodiments. Obviously modifications and alterations will occur to others upon a

reading and understanding of this specification. For example, although a double-ended envelope is illustrated, single-ended lamps where the lead wires extend from the same end of the lamp are also contemplated. The invention is intended to include all such modifications and alteration in so far as they come within the scope of the appended claims or the equivalents thereof.

WHAT IS CLAIMED IS:

1. A light source comprising:

a lamp envelope made of a light transmissive material, wherein the envelope has an ellipsoidal portion disposed centrally between tubular portions disposed on opposite ends of the ellipsoidal portion;

a filament centrally disposed within the envelope;

an infrared reflective filter coating disposed on at least a portion of the lamp envelope in surrounding relation to the filament;

a totally reflecting coating disposed on at least one end of the envelope in surrounding relation to the filament.

2. The light source of claim 1 further comprising a pair of lead wires connected to opposite ends of the filament for energizing the filament.

3. The light source of claim 1 further comprising a lead wire connected to an end of the filament and for energizing the filament.

4. The light source of claim 1 wherein the ellipsoidal portion having first and second foci associated therewith; and wherein the length of the filament fits substantially between the first and second optical foci for absorbing substantially all the radiation reflected from the infrared reflective filter and the totally reflecting coating.

5. The light source of claim 1 wherein the infrared reflective filter coating has alternate layers of respective high and low refractive indices for selectively passing desired radiation through and reflecting unwanted radiation to the filament

6. The light source of claim 5 wherein the unwanted radiation includes infrared radiation.

7. The light source of claim 1 wherein the totally reflecting coating directs radiation towards the filament.

8. The light source of claim 1 wherein the totally reflecting coating is disposed on portions of both ends of the envelope subtending an angle from approximately 22° and greater from an axis aligned with the filament.

9. The light source of claim 1 wherein the totally reflecting coating is disposed on both ends of the envelope subtending an angle from approximately 22° to 45° from an axis aligned with the filament.

10. A light source comprising:

a lamp envelope made of a light transmissive material;

a filament disposed within the envelope;

an infrared reflective filter coating disposed on at least a portion of the lamp envelope in surrounding relation to the filament;

a totally reflecting coating disposed on and end of the envelope in surrounding relation to the filament.

11. The light source of claim 10 wherein the totally reflecting coating is provided on both end regions of an ellipsoidal portion of the envelope.

12. The light source of claim 10 wherein the totally reflecting coating is provided on end regions of an ellipsoidal portion of the envelope and tubular portions extending from opposite ends of the ellipsoidal portion.

13. The light source of claim 12 wherein the ellipsoidal portion has first and second foci associated therewith; and wherein the length of the filament is located substantially between the first and second optical foci for absorbing substantially all the radiation reflected from the infrared reflective filter and the totally reflecting coating

14. The light source of claim 10 wherein the infrared reflective filter coating has alternate layers of respective high and low refractive indices for selectively passing desired radiation through and reflecting unwanted radiation to the filament.

15. The light source of claim 14 wherein the unwanted radiation includes infrared radiation.

16. The light source of claim 10 wherein the totally reflecting coating directs radiation towards the filament.

17. The light source of claim 10 wherein the totally reflecting coating is disposed on portions of both ends of the envelope subtending an angle from approximately 22° and greater from an axis aligned with the filament.

18. The light source of claim 10 wherein the totally reflecting coating is disposed on both ends of the envelope subtending an angle from approximately 22° to 45° from an axis aligned with the filament.

19. The light source of claim 18 wherein the totally reflecting coating is provided on end regions of an ellipsoidal portion of the envelope and tubular portions extending from opposite ends of the ellipsoidal portion.

20. The light source of claim 10 further comprising a reflector receiving visible light from the light source, the totally reflecting coating matching useful reflecting areas of the reflector .

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IR-COATED HALOGEN LAMP USING REFLECTIVE END COATS

ABSTRACT OF THE DISCLOSURE

A halogen infrared lamp (100) having an infrared reflective coating (118) along with a totally reflecting coating (120) on ends of an ellipsoidal portion of the envelope. The totally reflecting coating reflects the infrared radiation escaping at acute angles and directs the infrared radiation towards the filament to increase the temperature of the filament and thus increase the efficacy of the lamp. The totally reflecting coating may also extend to portions of tubular members extending from the ellipsoidal portion of the envelope.

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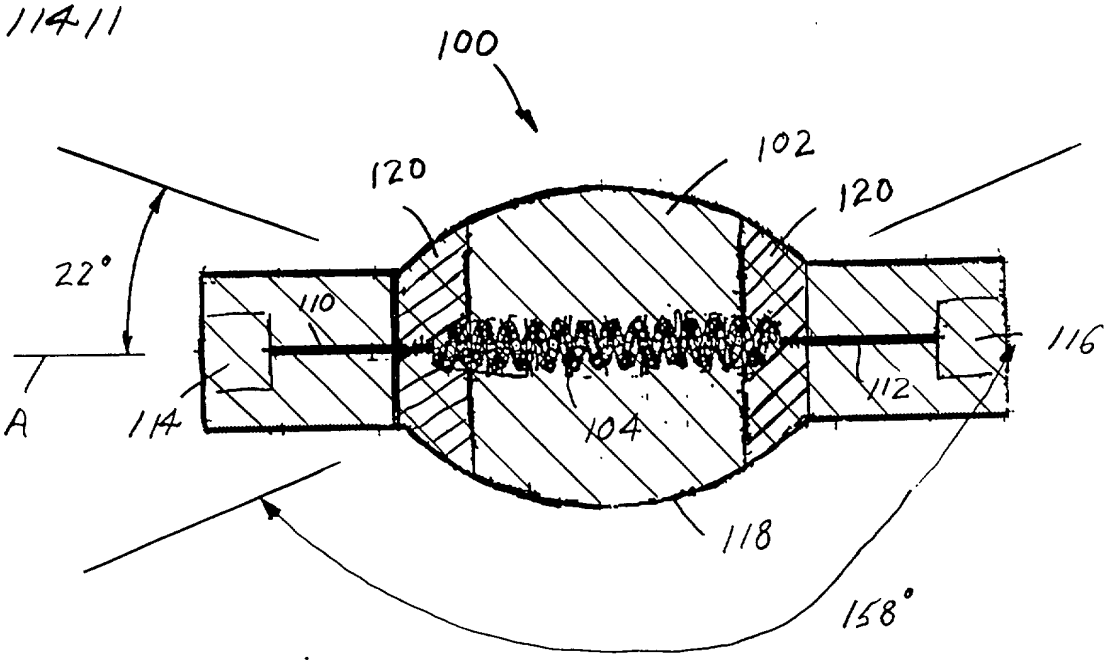

FIG. 1

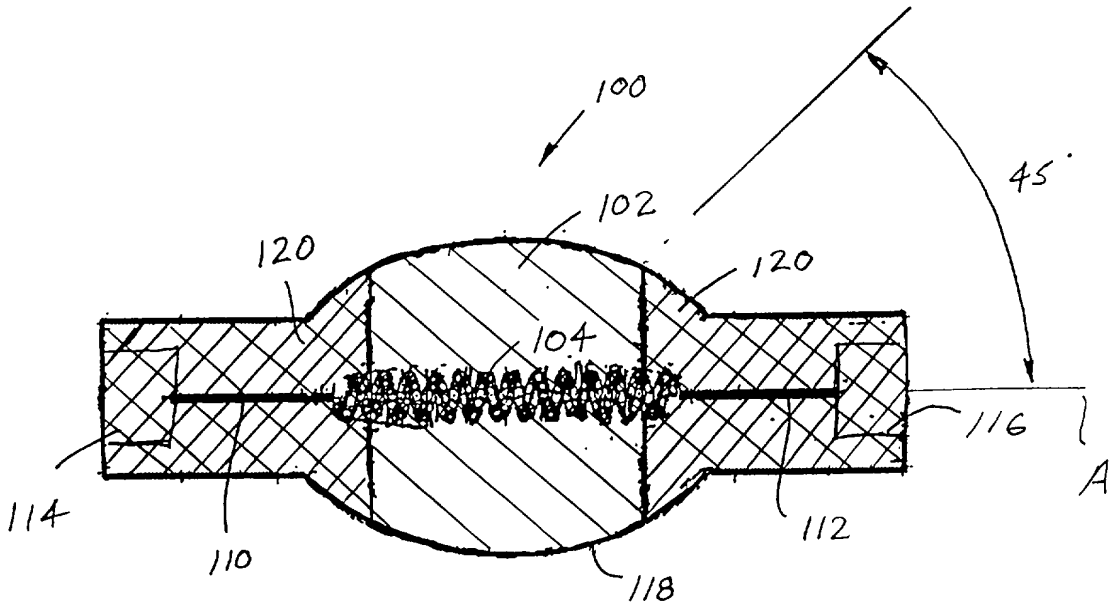

FIG. 2

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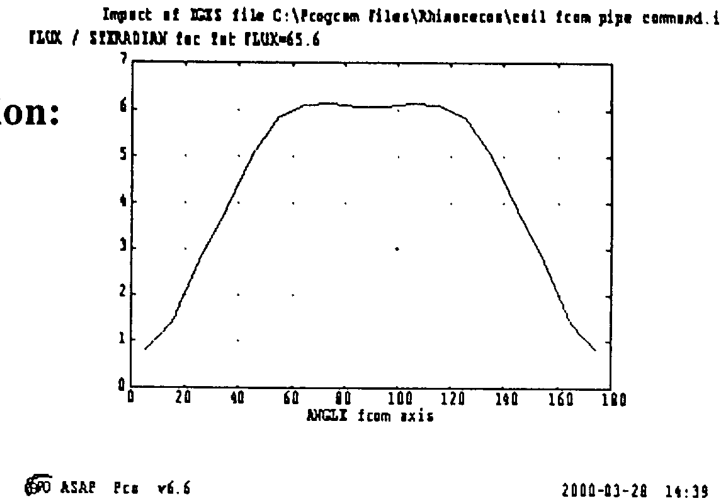
ASAP Predictions:

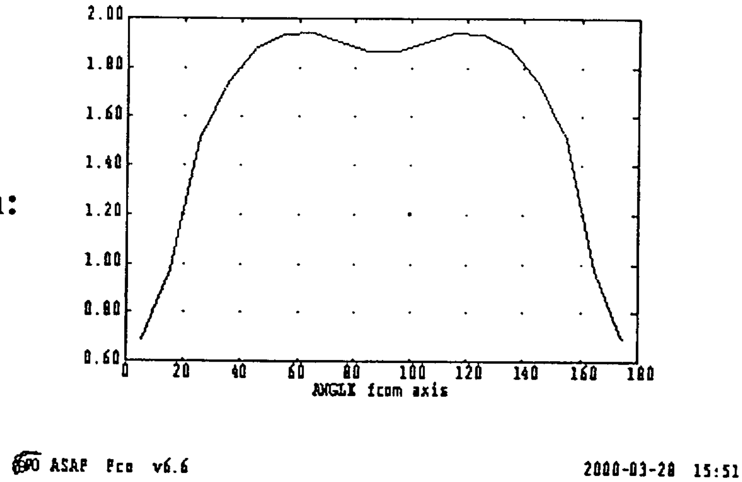
Visible Region:

FIGURE 3



IR Region:

FIGURE 4



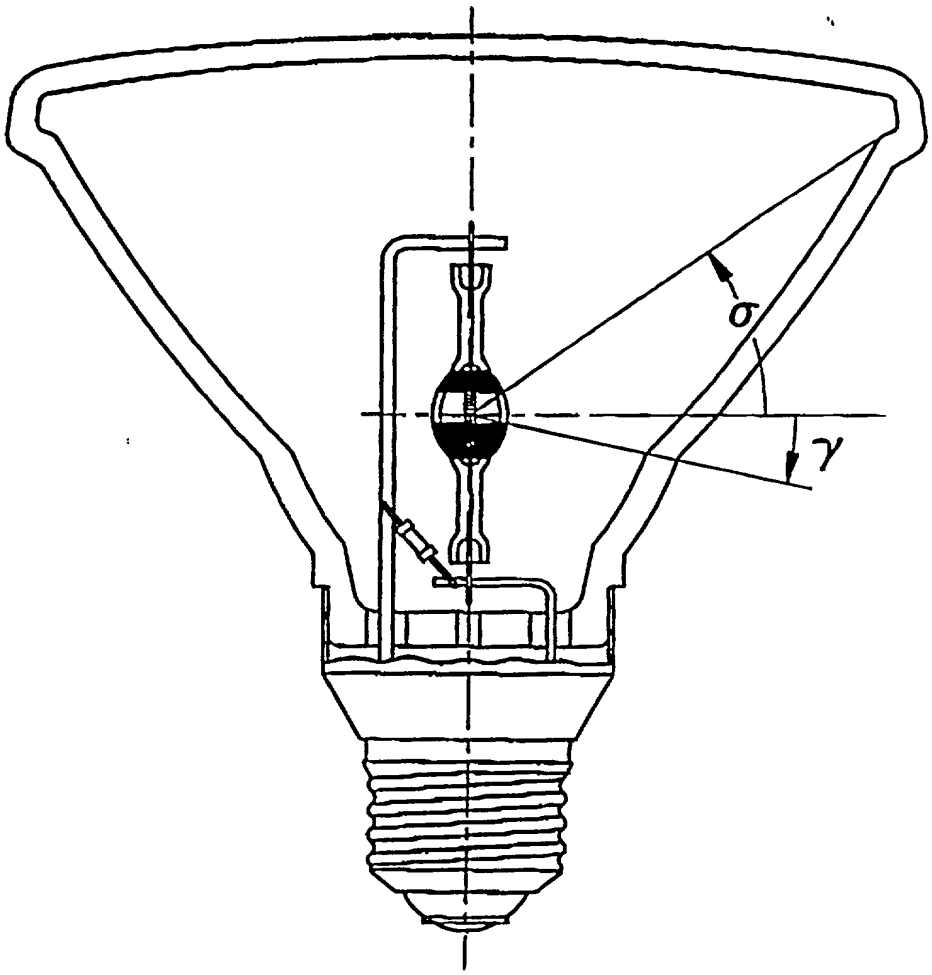


Fig. 5

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

IR-COATED HALOGEN LAMP USING REFLECTIVE END COATS

the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

(Number)	(Country)	(Day/Month/Year Filed)
N/A		

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below:

(Serial No.)	(Day/Month/Year Filed)
N/A	

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information which is material to patentability as defined in Title 37, of Federal Regulations Code, §1.56(a) which became available between the filing date of the prior application and the national or PCT international filing date of this application:

N/A
(Application Serial No.) (Filing Date)

Status:
(Patented, Pending, Abandoned)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Date: _____

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Date: ______________________________

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